Breaking the Scalability Limit of Multi-Projector Calibration with Embedded Cameras

Supplementary Material

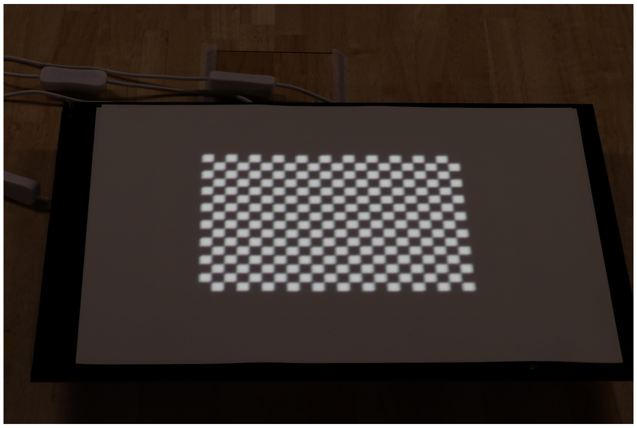

Figure 13. Our prototype covered by a white paper for projection.

In this supplementary material, we present detailed information and evaluation on our proposed method for multi-projector alignment in Sec. 6, projector calibration in Sec. 7.

6. Additional Evaluation of Multi-Projector Alignment

In this section, we report additional evaluations of alignment with two projectors and with twenty-five projectors in Sec. 4 of our main paper. In alignment experiments, a white paper covered our prototype board to make the projected images clear (Fig. 13).

6.1. Two Projectors

To evaluate the alignment accuracy, we computed MTF on the horizontal axis in our main paper (Fig. 9). We used images of the board, sinusoidal patterns were projected onto, captured by an external camera (Fig. 14). Though we reported the contrast evaluation only on the horizontal axis, we present that on the vertical axis (Fig. 15). There was little difference in modulation transfer among the methods (Proposed with comp., Proposed w/o comp., and Conventional). This result was obtained from the experimental condition where the two projectors were placed horizontally, resulting in less vertical misalignment than horizontal misalignment.

6.2. Twenty-five Projectors

To evaluate alignment accuracy with twenty-five projectors, we placed the board on a table and adjusted its position so

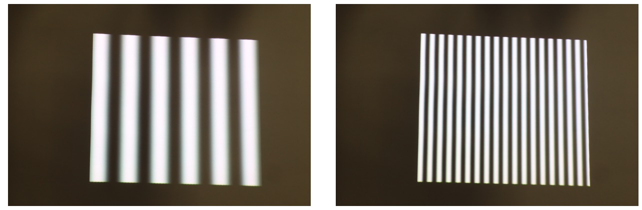

Figure 14. Example images used for contrast evaluation.

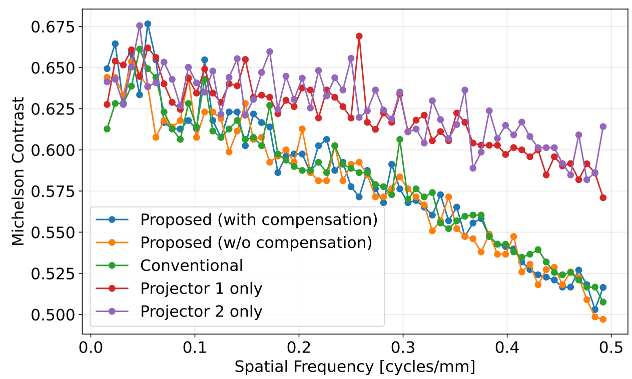

Figure 15. MTF comparison on the vertical axis for the two-projector alignment.

Figure 16. Overlapping pattern projected on the board (left) and an image captured by one of the embedded cameras (right).

that all embedded cameras captured rays from all projectors.

When twenty-five projectors simultaneously project a structured light pattern, the projected patterns overlap, making it difficult to separate them from the image captured by an external camera, as shown in Fig. 10a. However, embedded cameras capture the rays from all projectors simultaneously, and which projectors are casting the ray (Fig. 16). Fig. 17 shows the projected patterns from each of the 25 projectors to see how the overlapping pattern is composed.

We also present additional results obtained using twenty-five projectors with homographies computed by our proposed method. Fig. 18 shows additional results of twenty-

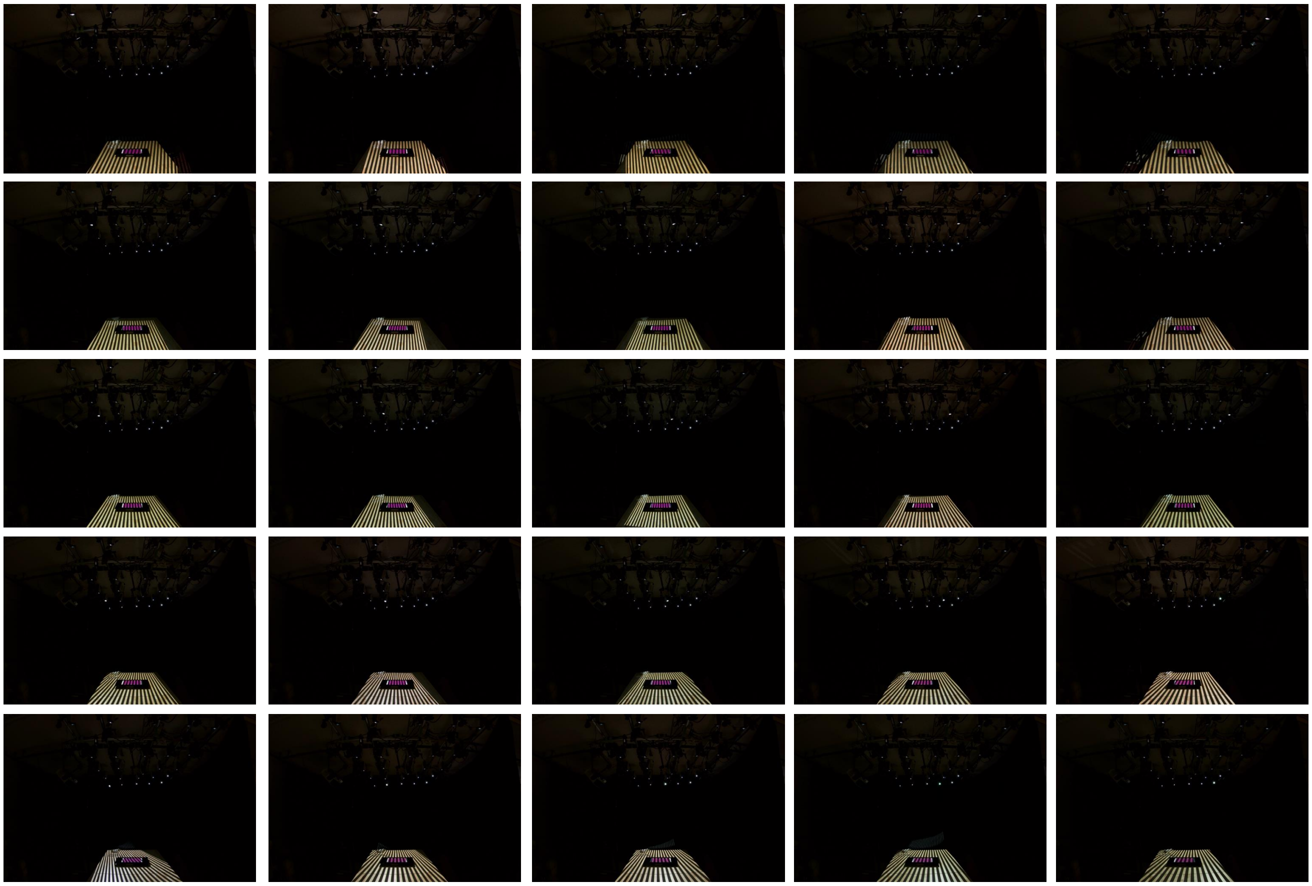

Figure 17. Graycode pattern projection from each projector. An active projector on the ceiling is projecting the same pattern from different angles onto the table.

five projections. Overall, our method produced sharper and clearer images compared with both the version without compensation and the conventional condition, as well as Fig. 10.

7. Projector Calibration

Lastly, we report the visualized results of all reprojection errors at each checker corner for the projector calibration experiment in Sec. 4.4. Figures 19, 20, and 21 present the spatial distribution of these errors for the conventional baseline, the proposed method without compensation, and the proposed method with compensation, respectively.

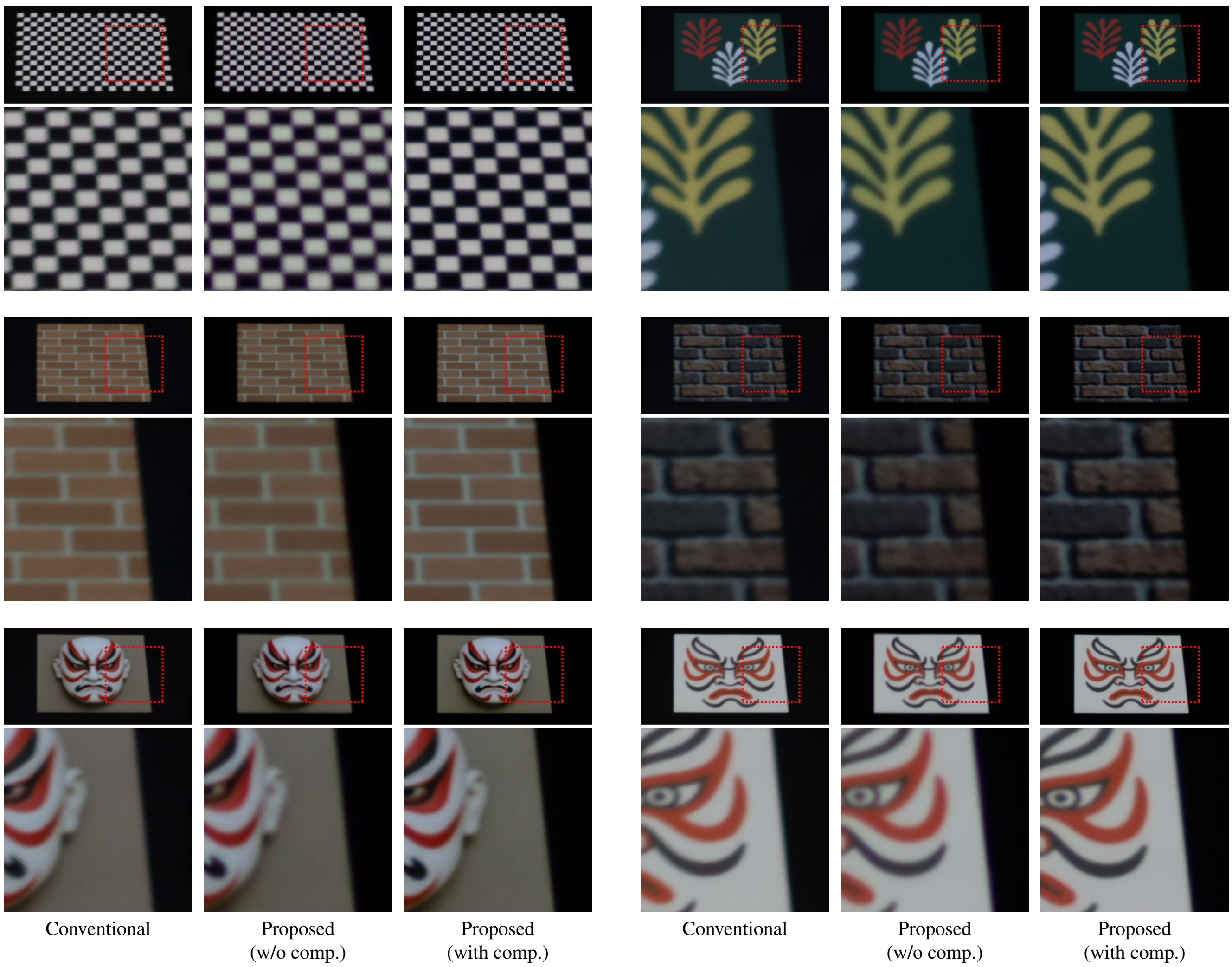

Figure 18. Additional results of twenty-five projections

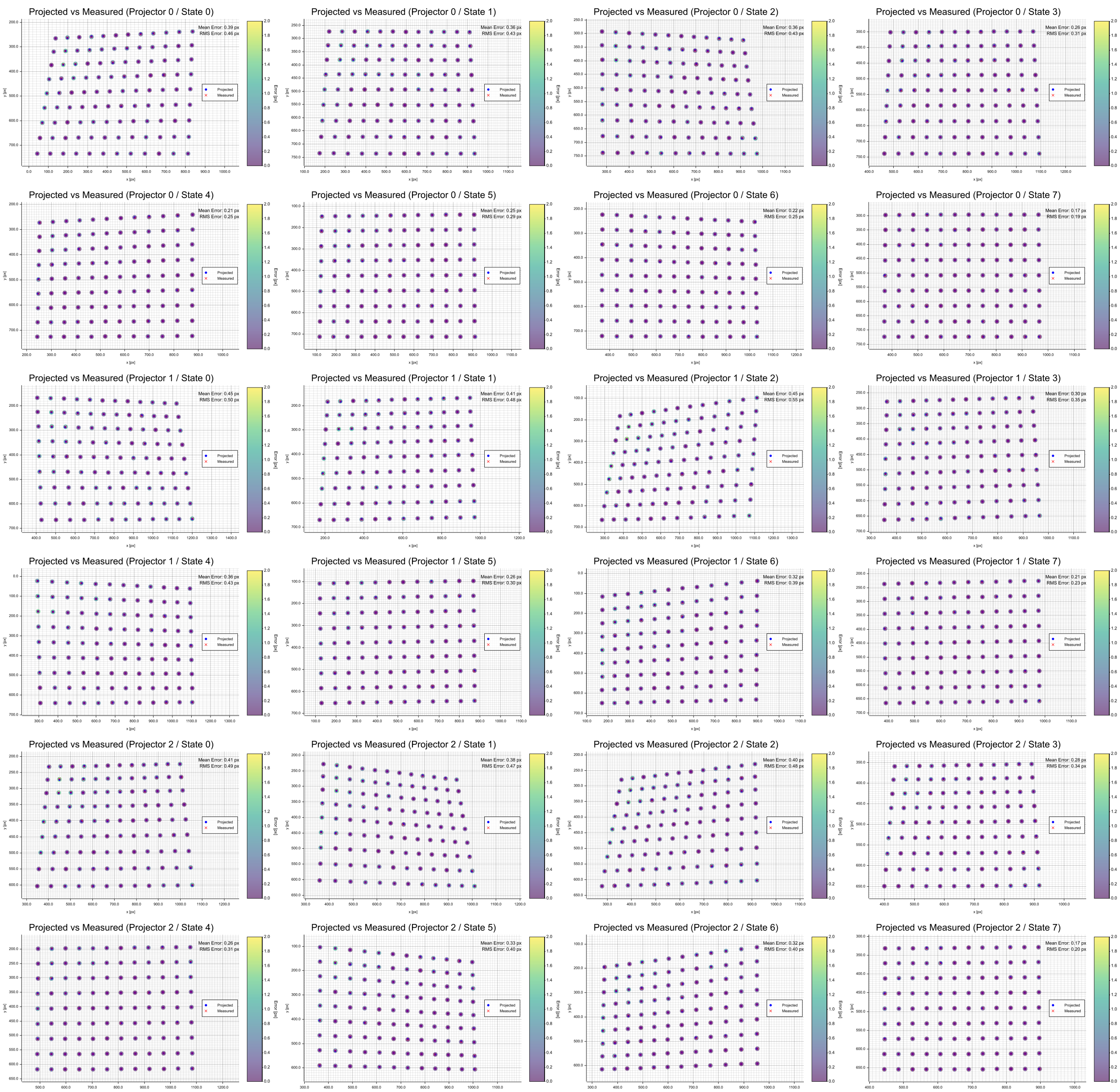

Figure 19. All reprojection errors of the conventional method.

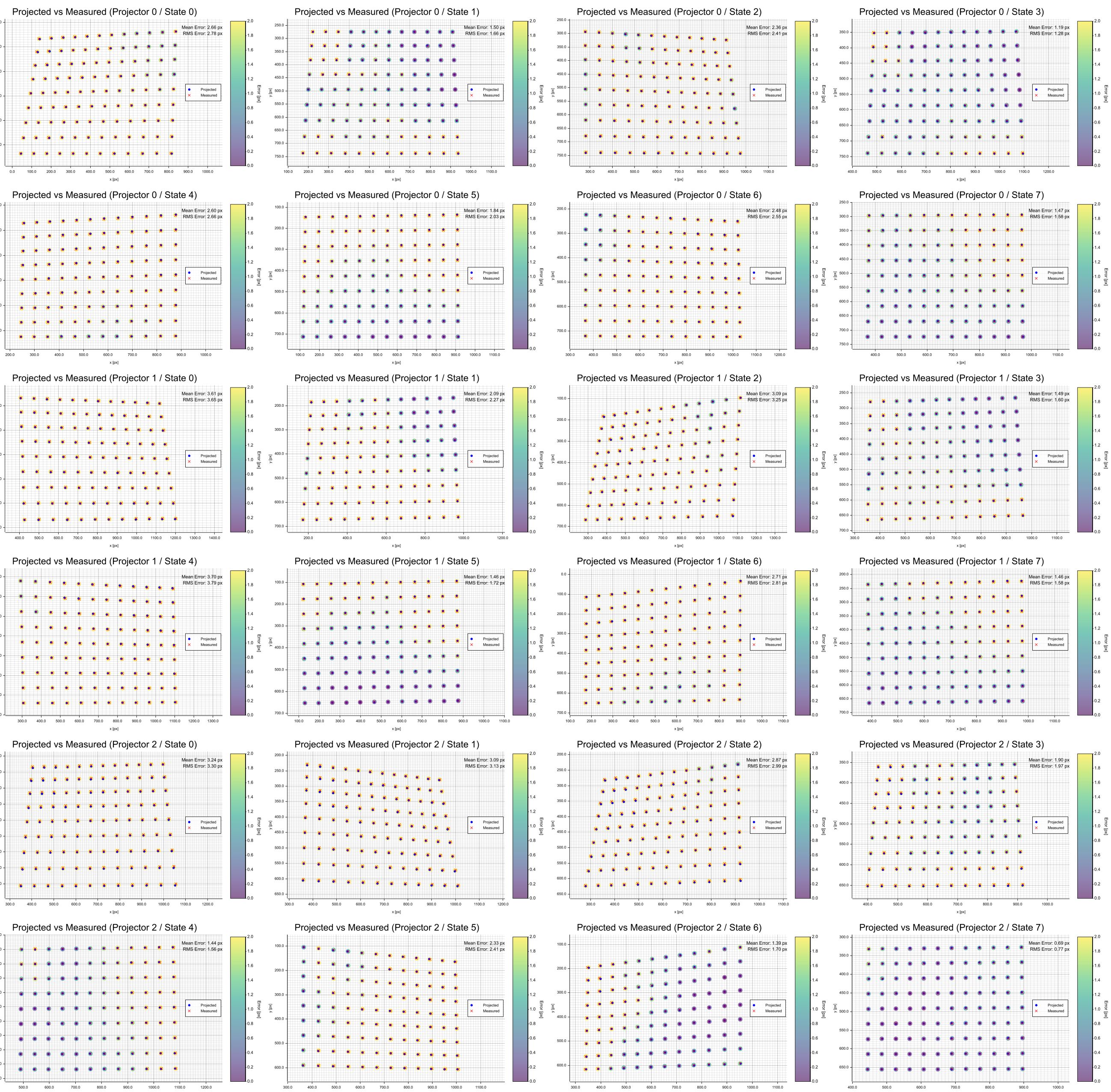

Figure 20. All reprojection errors of the proposed method w/o comp.

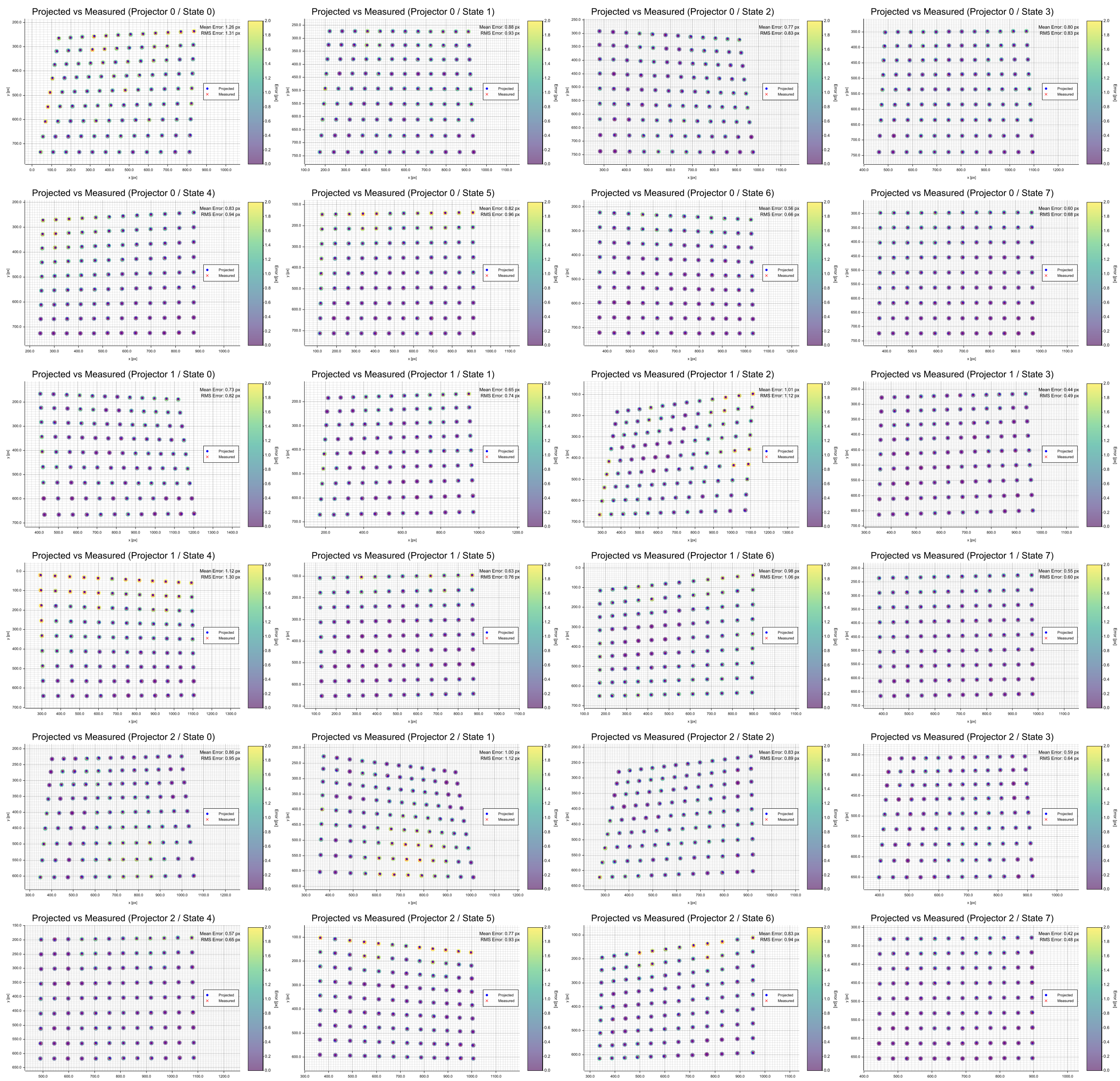

Figure 21. All reprojection errors of the proposed method with comp.